COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF TELECOMMUNICATIONS AND ENERGY

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Boston Edison Company, Cambridge	)	**D.T.E. 03-121**
Electric Light Company, and	)	
Commonwealth Electric Company	)	
d/b/a NSTAR Electric	)	
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DIRECT TESTIMONY OF MARK B. LIVELY

Docket No. DTE 03-121
Exhibit Joint Supporters-MBL-1
2004 March 16
Before Hearing Officer J. Cope-Flanagan

DIRECT TESTIMONY OF
MARK B. LIVELY
DATED 2004 MARCH 16
ON BEHALF OF
JOINT SUPPORTERS
EXHIBIT JOINT SUPPORTERS-MBL-1
IN
D.T.E. No. 03-121: NSTAR ELECTRIC
BEFORE HEARING OFFICER J. COPE-FLANAGAN

INTRODUCTION

Q. What are your name and address?

A. My name is Mark B. Lively. My address is 19012 High Point Dr., Gaithersburg, Md., 20879. I am an engineering consultant specializing in pricing issues related to natural gas and electricity.

PURPOSE

Q. What is the purpose of your testimony in this proceeding?

A. My testimony in this proceeding is to address problems with the Standby Service rate structure proposed by NSTAR Electric as supported by its witness Henry LaMontagne. In doing so, I will identify some economic benefits that distributed generation can provide to the community. One economic benefit is the removing load from the distribution grid, potentially relieving congestion and deferring expensive upgrades to the distribution grid. This can also lower the locational marginal price in that location. I will show how the firm Standby Service rate structure proposed by NSTAR Electric appears to be a blatant attempt to inflate its revenue at the expense of its customers, trying to keep customers with distributed generation to keep paying for what they don't use and isn't built for them. I will then show how the interruptible Standby Service rate structure should be realigned into a dynamic price for distributed generation including reactive power.

Q. Can you summarize the parts of your testimony regarding the economics of the NSTAR Electric Standby Service rate proposal?

A. My testimony regarding the economics of the proposed NSTAR Electric Standby Service tariff proposal can be summarized in the following points.

- Locating distributed generation on Poor Performing Circuits, identified in the Department's Annual Quality Service Reports, lowers costs for all ratepayers (line 212).

- Contrary to NSTAR Electric testimony, distribution systems are not configured "exactly" the same for DG and non-DG customers (line 236).

- Customers with DG do not have a significantly different load profile than non-DG customers (line 291).

- With the proposed standby rates, NSTAR Electric will over-collect from DG customers (line 320).

- NSTAR Electric's cost-of-service study approach is flawed and/or misunderstood by its own witness (line 381).

- There is no basis for revenue collection to be more fixed than the otherwise applicable rates (line 448).

- NSTAR Electric's proposed interruptible Standby Service should be priced lower than otherwise applicable rates because the quality of service offered under the proposed interruptible rates is lower (line 472).

- Dynamic tariffs are a much better solution to pricing standby service for distributed generation customers than NSTAR Electric's proposed rates, but dynamic tariffs require trust and cooperation between NSTAR Electric and its customers (line 514).

I believe that the first step in creating that trust and cooperation is for the Department to empower the customer to be a full participant in the competitive marketplace, by enabling the customer to utilize the full range of supply and demand side options currently available.

Q. For whom are you testifying?

A. I am testifying on behalf of Joint Supporters, Massachusetts Division of Energy Resources (MA-DOER), and Conservation Law Foundation.

EDUCATION AND EXPERIENCE

Q. What are your educational background and experience?

A. I earned a Bachelor of Science degree in electrical engineering from the Massachusetts Institute of Technology in 1969. I earned a Master of Science degree in management from the Massachusetts Institute of Technology's Sloan School of Management in 1971. I am a registered professional engineer in the District of Columbia.

From 1971 to 1976, I worked for American Electric Power Service Corporation (AEPSC) in New York City, first in the Controller's Office, then in the Rate Department. At that time, AEPSC provided engineering and management services to its utility affiliates in Indiana, Michigan, Ohio, West Virginia, Kentucky, Virginia, and Tennessee. While in the rate department of AEPSC, I received on the job training on issues related to pricing electricity, including cost analysis.

From 1976 to 1991, I worked as a consultant in the Washington, D.C., utility office of the accounting firm of Ernst & Ernst, and its successors, first Ernst & Whinney and then Ernst & Young, which I will collectively refer to as "Ernst". The Washington utility office provided audit, tax, and consulting services to its clients on electric and natural gas matters. My clients at Ernst included utilities, large industrial consumers, independent power producers, and regulators. I note that one of the utility clients for whom I worked was Commonwealth Gas, which is now an NSTAR company.

Since the beginning of 1992, I have been self-employed as a utility economic engineer specializing in the costing and pricing of electricity and natural gas. For the purpose of this proceeding, I am a consultant to The E Cubed Company, L.L.C.

Q. Have you testified in regulatory proceedings?

A. Yes. While I was with AEPSC I testified for the affiliated Michigan Power Company before the Michigan Public Service Commission on accounting adjustments, cost allocation, and rate design.

While with Ernst, I testified before the Arkansas Public Service Commission, the Louisiana Public Service Commission, the Montana Public Service Commission, the Texas Public Utilities Commission, and the New Mexico Public Service Commission. Generally my testimony was on the issue of cost allocation, with some testimony on budgetary forecasts and innovative rate design.

A substantial amount of my testimony before the Texas Public Utilities Commission is relevant to this proceeding in that there I testified on how utility pricing interacted with generation owned by the utility customers. How utility pricing interacts with generation owned by the utility customer is the whole concept behind a standby tariff.

Since being self employed, I have testified before the Texas Public Utilities Commission on rate design, before the Public Service Commission of the District of Columbia on behalf of the D.C. Office of People's Counsel on accounting issues in the failed merger between the Baltimore Gas & Electric and Potomac Electric Power, and before the New York Public Service Commission in a proceeding on behalf of St. Lawrence Gas Company and in proceedings on distributed generation on behalf of the Joint Supporters.

I have also filed comments in various FERC proceedings including RM01-12, FERC's current investigation into a Standard Market Design for Independent System Operators.

Q. Have you written any published papers or articles?

A. Yes. *Public Utilities Fortnightly* published several of my articles, beginning in 1989, and a few smaller commentaries. These articles include

- "Tie Riding Freeloaders--The True Impediment to Transmission Access," 1989 December 21;
- "WOLF Pricing," 1994 October 1;
- "Electric Transmission Pricing: Are Long-term Contracts Really Futures Contracts?" 1994 October 15;

- “Electricity Is Too Chunky: The Midwest power prices were neither too high nor too low. They were too imprecise,” 1998 September 1;

- “FERC’s Mandatory Gas Auctions: Are We Bidding the Right Product? -- Auctioning gas imbalances offers advantages over bidding on available pipeline capacity,” 1999 January 1;

- “FERC’s Dialogue on CBM: Reliability Gets Reappraised,” 1999 July 1;

- “Distributed Generation: Setting a Fair Price in the Distribution Tariff,”2000 October 15

- “Saving California With Distributed Generation: A crash program to use small, standby diesel generators to keep the lights on,” 2001 June 15

- "Keeping the Lights On: An Insurance Industry Model . . . to Stop Manipulation," 2002 July 1

The National Regulatory Research Institute (NRRI) has also published a few of my articles in its *Quarterly Bulletin*. NRRI is affiliated with the National Association of Regulatory Utility Commissioners. The articles published in the NRRI *Quarterly Bulletin* include

- "The FERC's Formula for Transmission Contacts: Using a Good Concept for the Wrong Service," Winter 1995

- "Thirty-One Flavors or Two Flavors Packaged Thirty-One Ways: Unbundling Electricity Service" Summer 1996

- “State Regulation of the Coming Competitive Market,” Fall 1997

- "Electric Customer Participation in the Competitive Market: Reliability, Futures Contracts, and Arbitraging," Winter 1997

- "Metrics for Operating Reserves," Spring 1998

- "Daily Cashouts of Gas Imbalances Using A Formulary Auction," Fall/Winter 1999

- "Good Market Segmentation or Bad: An Analysis of the California Electricity Market, Autumn 2000

- "Fungible Distribution Tariffs: Supporting Distributed Generation Without Bankrupting the Utility," Winter 2001

McGraw-Hill's Electrical World published an article I wrote in 1991. I have also presented papers to conferences sponsored by the American Society of Mechanical Engineers, the American Nuclear Society, and the Institute of Electrical and Electronics Engineers. I attach my complete resume as Exhibit Joint Supporters-MBL-2.

NSTAR ELECTRIC'S PROPOSAL

Q. How does NSTAR Electric plan to charge Standby Service customers?

A. NSTAR Electric has developed a contract demand tariff which collects all revenue through a fixed charge based on a customer's contract demand. The contract demand has a 100% ratchet and is invariant in the revenue it collects each month. The contract demand is related to the capacity of the distributed generation. This will require the customer to allow the utility behind the utility meter to determine the capacity of the distributed generation and how it is operating. The payments for the contract demand would be independent of the actual usage the customer makes of the distribution grid. NSTAR Electric also wants to introduce an interruptible rate that charges customers with distributed generation the general service rate but would force the customer to interrupt service. These tariff schedules inappropriately suggest that distributed generation increases the utility costs instead of providing benefits to other utility customers.

BENEFITS OF DISTRIBUTED GENERATION

Q. What are the benefits of distributed generation?

A. Distributed generation can relieve congestion on the distribution grid, reduce electrical losses on the distribution grid, and provide voltage support on the distribution grid. In doing so, distributed generation will lower the locational marginal price on the electric grid, providing general benefits to all consumers. There are also benefits to individual consumers associated with lower cost, less pollution, and increased reliability, but these latter benefits to the community are much less than the indirect effect of lowering locational marginal price.

Q. You discuss distributed generation from the perspective of individual consumers. Does distributed generation provide a benefit to the utility's entire customer base?

A. Distributed generation can provide a benefit to the utility's entire customer base, but that is not the issue in this proceeding. This proceeding deals with NSTAR Electric's proposed Standby Service tariff schedule. As such, this proceeding deals with customers who have installed distributed generation for their own purposes as a way to increase their own customer satisfaction. Yes, distributed generation can lower the cost that the utility incurs for service to its other customers, but such a lowering of cost is not the issue being addressed here, except possibly in regard to NSTAR Electric's interruptible Standby Service.

Q. How can distributed generation lower the cost that a utility incurs for service to its customers?

A. A utility has many options for how it provides service to its customers. One of those options is for the utility to install distributed generation, though Massachusetts now limits that option. That option could be important for utility service in remote areas, areas that are so remote that the construction of a distribution line to that area is prohibitively expensive. Distributed generation could allow the utility to meet its service obligation at a lower cost than the construction of the distribution line. As I understand Massachusetts law, such distributed generation would need to be owned by a third party, not the utility.

Though there are few, if any, areas served by NSTAR that are so remote to fit into the above example, some utilities own mobile generators to backup their distribution grid. Such backup can include times of maintenance on the distribution grid. Some have advocated using mobile generators during peak summer periods to supplement the capacity of overloaded substations and feeders until such time that the substation and feeders can be reinforced. Such mobile generators would meet the definition of distributed generation, and could be owned by a third party.

Such backup can also occur when a customer requires higher levels of reliability. The customer could be served with power coming from two different substations with two different feeders, or the customer could be served with power from a backup generator. However, these examples of higher reliability of service are generally beyond what a utility would normally offer through its standard tariff. The utility might offer it as a line extension for a second feed, still under the utility's tariff but not under the part with which most consumers deal.

But these benefits associated with distributed generation are generally outside the scope of these proceedings except in regard to the interruptible Standby Service scheduled introduced by NSTAR Electric.

Q. How would the interruptible Standby Service relate to distributed generation lowering the cost of NSTAR Electric providing service to its other customers?

A. NSTAR Electric believes that it is appropriate to offer an interruptible Standby Service for distributed generation, describing the process by which distributed generation customers can take that service and the process by which the utility would interrupt that service during periods when the local distribution grid is overloaded. This suggests to me that NSTAR Electric has some poorly performing feeders that are nearing the time for them to be upgraded. One way to extend their current life is to interrupt service to customers with distributed generation. This would delay when the upgrade would be required.

I note that the Department requires the NSTAR Electric companies to file Annual Service Quality Reports (ASQR). In reading Appendix 10 to the Cambridge Electric Company ASQR for 2003, I noted that Cambridge Electric reported 15 Poor Performing Circuits. Though many of the outages are attributable to lightning, these circuits might fall in the category mentioned above that could benefit from an interruptible tariff pricing to encourage a reduction in consumption during periods of stress on the distribution circuit.

I consider interruptible service to be a form of dynamic pricing. Dynamic refers to changing the price in response to concurrent conditions. In the case of NSTAR Electric's interruptible Standby Service, the concurrent conditions are the level of loading on the local distribution grid. When the local distribution grid is overloaded, or when NSTAR Electric says that the local distribution grid is overloaded, the price for service is very high. At other times, the price for service is very low. The concept introduced by NSTAR Electric in its interruptible Standby Service can be used to encourage distributed generation to be located in areas that NSTAR Electric needs to reinforce. The efficiencies associated with such a decision would lower the locational marginal cost in the area and thus lower the cost to all consumers, not just the consumer with distributed generation.

COST OF SERVING CUSTOMERS WITH DISTRIBUTED GENERATION

Q. Do you agree that the distribution system needs to be configured "exactly" the same way for standby customers as it is for non-standby customers?

A. No. There are very few distribution systems that are exactly the same, even with almost identical customers. There are always some idiosyncrasies that will lead to slight differences, if for no other reason that customers differ from each other. The configuration will depend on the expectation of the maximum diversified demand that the distribution system will be expected to carry. This will be much less than the sum of the individual demands of each customer, because of diversity. The customers don't peak in their electrical consumption at the same time, except for peaks driven by weather, and even then there is some diversity in consumption.

Q. Are the efficiencies associated with distributed generation a factor in the firm Standby Service proposed by NSTAR Electric in this proceeding?

A. The efficiencies associated with distributed generation should be a factor in ensuring that distributed generation should be treated fairly. Otherwise, the efficiencies associated with distributed generation should not be a factor in the firm Standby Service proposed by NSTAR Electric in this proceeding, at least not under standard embedded cost based ratemaking used by most utility commissions.

Under embedded cost based ratemaking, the purpose for which a consumer uses electricity is not a consideration in setting prices. Certainly the customer's load pattern imposed on the utility is an issue in determining the cost allocated to the customer. But the purpose for which the customer uses the electricity should not be an issue, unless mandated by the legislature or a similarly appropriate body. For distributed generation, the benefit provided by having distributed generation on the network makes it important that we do not burden customers with distributed generation with additional costs.

Q. Do customers with distributed generation have a load pattern that is more costly than are the load patterns of customers without distributed generation?

A. Generally not. Some customers with distributed generation have load patterns that may be considered to be more costly than the load patterns of customers without distributed generation under some costing mechanisms. But there are a variety of costing mechanisms, and for other costing mechanisms these same customers with distributed generation have load patterns that may be considered to be less costly than the load patterns of customers without distributed generation. Thus the result may depend more on the choice of the costing mechanism than the load pattern of the customer.

Q. Do standby customers cause costs to be incurred by the company in the same manner as comparable non-standby customers?

A. Not necessarily. As I stated above, customers with distributed generation will have different load patterns than customers without distributed generation. And the cost incurrence will depend on the choice of costing mechanism. The different load patterns may lead the engineer to design the system in slightly different manners for two customers with the same peak demand since they will have different contributions to diversified demand on the distribution system.

Q. Does the costing mechanism used by NSTAR Electric show that customers with distributed generation are more costly than customers without distributed generation?

A. Apparently not. Nowhere in the testimony of Henry LaMontagne is there a reference to an NSTAR Electric cost study that compares the cost of serving a customer with distributed generation to the cost of serving a customer without distributed generation. If there were such a cost study, then NSTAR Electric should have produced the study as part of its direct case in this proceeding in support of its attempt to increase the revenue it collects from customers with distributed generation. I have not even seen NSTAR Electric present any load data that suggest that customers with distributed generation have a significantly different load profile than do customers without distributed generation. In fact, I understand that Elaine Saunders, the witness for The Energy Consortium, will present data suggesting the opposite result.

Q. Why do you say the Ms. Saunders data will suggest the opposite result?

A. My understanding is that Ms. Saunders has data from another Massachusetts utility. Further, my understanding is that Ms. Saunders' data relate to the annual billing demand ratio. I understand that the data show that customers with distributed generation have annual billing demand ratios that are insignificantly different from the annual billing demand ratios of similarly sized customers without distributed generation. If customers with distributed generation have the same annual billing demand ratios as customers without distributed generation, they should not be discriminated against as NSTAR Electric has proposed to do with its Standby Service proposal.

Q. What is an annual billing demand ratio?

A. During a conference call on this proceeding, Ms. Saunders described producing what I am calling an annual billing demand ratio as the division of non-peak billing demand by the maximum billing demand during the year. Her experience with another utility has shown that these annual billing demand ratios are insignificantly different when computed for customers with distributed generation versus when computed for customers without distributed generation.

Q. What does annual billing demand ratio have to do with the cost of serving customers?

A. The annual billing demand ratio primarily deals with how a utility collects revenue from its customers. The annual billing demand ratio indicates the amount of revenue a utility will collect per unit of annual maximum demand. The revenue per unit of annual maximum demand is important because the utility incurs costs in proportion to a customer's annual maximum demand. Having the same annual billing demand ratio suggests that the utility will collect the same unit revenue from both the customers with distributed generation as it will from customers without distributed generation. This suggests that the utility will over collect from customers with distributed generation relative to customers without distributed generation.

Q. Why would similar annual billing demand ratios suggest that a utility will over collect from customers with distributed generation relative to customers without distributed generation?

A. Given similar annual billing demand ratios, the utility will over collect from customers with distributed generation because customers with distributed generation will not incur as much cost per unit of annual maximum demand as will customers without distributed generation, even though the pay much the same revenue.

Under the demand based pricing used by NSTAR Electric, the utility collects about the same revenue from the two groups of customers per unit of maximum billing demand. But the utility will incur less cost from the customer with distributed generation.

The utility incurs cost based on the highest diversified demand placed on its system. This highest diversified demand generally is proportional to the maximum billing demand. Thus, not only does the utility earn revenue in proportion to the maximum billing demand, the utility also incurs cost in proportion to the maximum billing demand, at least approximately.

Q. How does a utility incur cost in proportion to the maximum billing demand of a customer?

A. As I said previously, the cost incurrence is only approximately in proportion to the customer's maximum billing demand. The diversified demand is not equal to the maximum billing demand because consumers share the distribution system with each other. The sharing occurs because consumers have their peak demands on different days and different times. The relation between the diversified demand and the maximum billing demand is far from an exact ratio. Indeed, most load research suggests that the diversified demand ratio increases with the customer load factor. Thus, as a customer takes more electricity from the utility, its contribution to the diversified demand of the utility increases.

As the customer's contribution to the diversified demand of the utility increases, so do the costs that the utility incurs on behalf of the customer. Since a significant characteristic of customers with distributed generation is a low load factor, customers with distributed generation can be expected to have a low contribution to the diversified demand on the distribution system and thus a low level of cost per unit of annual maximum demand.

Customers with distributed generation are likely to have better load research characteristics than do customers without distributed generation. This result is due the cause or causes of the reliance by various customers on the distribution grid. For most customers, the peak consumption is driven by the weather. Thus, most customers without distributed generation are likely to be using the distribution grid at the same time as other customers are using the distribution grid, during the height of the summer air conditioning season. This lack of diversity makes weather sensitive customers very expensive to serve. In contrast, the demands placed on a distribution grid by customers with distributed generation are more likely to be associated with a random outage of the distributed generation, not weather. The random outage of the distributed generation is likely to result in the customer with distributed generation to contribute a smaller share of its maximum demand to the maximum demand on the distribution grid.

I note that the random nature of the outages of distributed generation makes them less expensive to serve instead of more expensive. This is in contrast to Mr. LaMontagne's assertion at page 16 of Exhibit NSTAR-HCL-1. Beginning at line 21 he refers to the infrequent use of the distribution grid. This infrequent use will have a greater effect on lowering the cost to serve customers with distributed generation than it will have on the revenue NSTAR Electric will collect from such customers.

Q. Mr. LaMontagne claims on page 19 of Exhibit NSTAR-HCL-1 that there is no diversity for customers with distributed generation because there might only be one on a circuit. Is this claim appropriate?

A. Mr. LaMontagne's claim is an indictment of the approach NSTAR Electric takes to class cost of service studies, or of his understanding of that approach. I agree with the basic fact that there might only be one distributed generation customer on a circuit. But there will be many other customers on that circuit. The engineers who design that circuit will need to estimate the maximum load that the circuit must be able to sustain. That maximum will be the diversified demand of all customers on that circuit. The allocation of costs should therefore be based on the likely contribution of the customer with distributed generation to this maximum demand on the distribution circuit. Mr. LaMontagne's claim is based on a cost of service simplification that becomes inappropriate for classes with small numbers of customers.

Q. Is it best practice for a distribution company to add distribution capacity to serve its standby customer on a kw-for-kw basis to meet the maximum non-coincident peak needs of each customer?

A. No. The distribution system is planned to meet the diversified demands of all of the customers on the network. When a customer adds a kw of non-coincident demand, the customer will generally increase its contribution to the diversified demand by much less than a kw. This diversified demand concept allows a utility to build its system much less expensively than if the utility were designing separate systems for each of the customers in a the area of the distribution system. This ability to design the system on the basis of the maximum diversified demand instead of the individual demands has lead to immense economies of scale and to the concept of natural monopolies that I mention elsewhere in my testimony.

Q. So, should customers with distributed generation pay a lower rate than customers without distributed generation?

A. I don't have the load research applicable to the NSTAR companies to be able to make that conclusion with finality. Certainly there is some logic associated with typical load research results that would suggest the conclusion that customers with distributed generation should be paying lower demand charges than customers without distributed generation. But at least some of this conclusion would depend upon how much of the utility's demand costs are being recovered through an energy charge instead of through a demand charge.

Though Mr. LaMontagne provides on page 10 of Exhibit NSTAR-HCL-1 a list of three policy goals he purports to have used in setting the rates for Standby Service, I note that he seems to have failed to achieve any of the goals. The goals essentially are to have cost based rates for Standby Service. Mr. LaMontagne's approach seems to develop a tariff that will recover more than NSTAR Electric's cost of providing service.

REVENUE OVERCOLLECTION

Q. Why did you say previously that NSTAR Electric is attempting to inflate its revenue?

A. NSTAR Electric has proposed a permanent ratchet on the billing demand in the form of a contract demand. Under the NSTAR Electric formulation of the contract demand, a customer will pay for the contract demand no matter the monthly consumption of electricity by the customer. Based on the evidence that I anticipate Ms. Saunders will file as a witness for The Energy Consortium, I understand that distributed generation customers already pay the same distribution of demand charges as do customers without distributed generation.

The contract demand charge concept would merely increase the billing determinants that NSTAR Electric would be allowed to bill without increasing the costs incurred by NSTAR Electric. This seems like a blatant attempt by NSTAR Electric to increase its revenue merely by making an erroneous assertion about the intermittent revenue NSTAR Electric will receive from customers with distributed generation.

Q. Why is the assertion about intermittent revenue erroneous?

A. The demand charge is the primary mechanism that NSTAR Electric uses to collect revenue from customers with distributed generation. The demand charge has historically been a way for a utility to smooth out its revenue variations. For instance, customers with distributed generation are significantly reducing the amount of energy they take from the utility but they have a hard time reducing the monthly demand that they take from the utility. The demand charge each month is based on the energy taken during the fifteen (15) minute interval with the highest energy. For a customer to avoid a demand charge, it must manage to avoid significant reliance on the utility for all 2,976 fifteen minute intervals during a thirty-one (31) day month. This produces significant revenue stability for the utility despite the intermittency of the customer's consumption of utility services.

Q. Should revenues be more fixed for customers with distributed generation, as proposed by NSTAR?

A. No. As I pointed out previously, Ms. Saunders' presentation is expected to show that the annual billing demand ratio for customers with distributed generation is not significantly different from customers without distributed generation. Thus, there is no reason to make the rates for customers to be more fixed than customers without distributed generation. In contrast, distributed generation can be competitively dispatched, we would want the rates to customers with distributed generation to be even more variable than rates to customers without distributed generation, as I point out later in regard to NSTAR Electric's proposal for interruptible rates.

Q. What are your conclusions about the NSTAR Electric firm Standby Service schedule?

A. My conclusions about the NSTAR Electric firm Standby Service schedule include the inappropriateness of the contract demand charge. I note that it merely serves to increase NSTAR Electric's revenue in an artificial manner with no load research to support the concept. Further, the information I anticipate from Ms. Saunders suggests that contract demand charge is unnecessary for NSTAR Electric to recover costs at the same level from distributed generation customers as it recovers from customers without distributed generation. Finally, standard load research results suggest that customers with distributed generation should pay lower demand rates than customers without distributed generation because of the lower diversified demands that customers with distributed generation place on the utility system.

INTERRUPTIBLE STANDBY SERVICE

Q. What is wrong with the interruptible Standby Service schedule?

A. The interruptible Standby Service schedule is discriminatory. As described by Mr. LaMontagne, a distributed generation customer taking interruptible Standby Service

- Would pay the otherwise applicable rate, but
- Would receive service that is inferior to the service received by customers on the otherwise applicable rate.

Further, I showed earlier that distributed generation customers cause NSTAR Electric to incur less cost than customers without distributed generation. This suggests that the utility is incurring less cost and is receiving more money for providing an inferior service. This is blatantly unfair. And this does not include any payment that the distributed generation customer might have to pay for not following the utility's potentially unfounded call for interruption.

Q. Why do you raise the issue of a potentially unfounded call for interruption?

A. Mr. LaMontagne has not presented a tariff that provides any specificity as to NSTAR Electric's procedure for calling for interruption. Indeed, he discusses negotiating the terms of such calls for interruption with each customer. There must be clear rules for any call for interruption, and they should be uniform within the tariff. The utility's ability to call for interruption changes the cost characteristics of a class of customers. This change in the cost characteristics of the interruptible class must be clearly enumerated.

I note that many interruptible tariffs allow the utility to test whether the customer can indeed interrupt the use of the service. All too often these calls for testing the ability of the customer to interrupt consumption alienate the customer. I believe that a better approach is to test the utility instead of testing the customer.

Q. How would you test the utility?

A. That Mr. LaMontagne has proposed an interruptible tariff suggests to me that NSTAR Electric has distribution grids that are nearly fully loaded, or that could become fully loaded under adverse situations. Otherwise there would be no use for NSTAR Electric to have Mr. LaMontagne include in his testimony any reference to interruptible Standby Service. The test of the utility is the willingness of the utility to pay distributed generators who help unload the distribution grid at the same time and location that the utility wants customers with distributed generation to interrupt.

ALTERNATIVE COSTING MECHANISMS

Q. How is paying distributed generation consistent with NSTAR Electric's costing mechanism?

A. Some utilities and some regulatory commissions advocate paying stand alone distributed generation based on the ability of the utility to defer upgrades to the utility's distribution system. This concept of avoided cost depends highly on cooperation between the utility and the distributed generator, and a great deal of trust, trust which has been rare in the electric industry between utilities and distributed generators. Using the deferral of upgrades to justify payments to distributed generators can be considered to be an intermediate run incremental cost savings analysis.

Since the concept of paying distributed generation based on the deferral of distribution upgrades is dependent on trust, and since such trust is almost nonexistent, I believe we need another way to determine the value associated with distributed generation. Thus I have developed a mechanism to tie the price of distributed generation to the real time market for electricity. Since those prices are dynamic, they can be equally applicable to electricity that the utility delivers to the customer and to any electricity that the customer delivers to the utility. This duality of pricing tests the earnestness of the utility in its resolve to have an interruptible service schedule. The customer then has a choice to interrupt or to pay the higher locational marginal price.

Q. How does this dynamic pricing mechanism work?

A. The pricing mechanism charges the concurrent marginal cost of the distribution system. During most time periods, the concurrent marginal cost of the distribution system is marginal electrical loss. During periods when the utility has established there is a constraint on the distribution system, as Mr. LaMontagne has described, the marginal cost of the distribution system is congestion cost. The pricing mechanism would be based on a system of formulas. The formulas would relate marginal distribution cost to measurements on the NSTAR system and to externally determined prices of electricity. The externally determined price of electricity might be the locational marginal price developed by ISO New England.

By relating the price of electricity to concurrent conditions on the distribution grid, the pricing mechanism would be dynamic, much like an interruptible tariff is dynamic. Interruptible tariffs are dynamic in that one price is applicable during most situations and a second price is applicable during the nominally rare situation when the distribution grid is overloaded. I have described this concept in

- "Pricing Distributed Resources: When Your Customer Can Be Your Supplier," *EnergyCentral*, 1998 June 9

- "Distributed Generation: Setting a Fair Price in the Distribution Tariff," *Public Utilities Fortnightly*, 2000 October 15

- "Fungible Distribution Tariffs: Supporting Distributed Generation Without Bankrupting the Utility," The *National Regulatory Research Institute Quarterly Bulletin*, Winter 2000.

I attach a copy of the latter article as Exhibit Joint Supporters-MBL-3. I note that as a supporter of the National Regulatory Research Institute through its participation in the National Association of Regulatory Utility Commissioners, the Department should have a copy of this article and the *National Regulatory Research Institute Quarterly Bulletin* in its library.

Q. Why are dynamic tariffs applicable to utilities, such as NSTAR Electric?

A. Dynamic tariffs are very applicable in competitive situations. Distributed generators are in competition with central station power plants. A dynamic tariff would allow an optimization of the operation of distributed generation. Some of that optimization is against central station power plants, such as those coordinated by ISO New England. But some of the optimization should be in regard to the operation of the distribution grid. When the distribution grid is heavily loaded, distributed generators should be encouraged to produce more electricity, reducing the heavy loading on the distribution grid. The appropriate price in such situations is normally related to the marginal cost of operating the distribution grid. In real time, the marginal cost of operating the distribution grid is marginal electrical losses.

Q. Would NSTAR Electric be able to recover the capital cost associated with its distribution grid with a dynamic tariff?

A. Since a dynamic tariff represents part of a competitive market, NSTAR Electric's revenue for the operation of the interruptible tariff would not be tied to its capital costs. NSTAR Electric might collect more revenue than would be justified under embedded cost ratemaking, or it might collect less revenue.

Under a competitive market, there is no guarantee that fixed costs are recovered. I note that marginal electrical losses are theoretically twice the average electrical losses. Therefore, whatever the dynamic price that is paid for the use of the distribution grid is twice the cost that is incurred for the electricity used in the operation of the distribution grid. Thus, the customer would be contributing to the fixed costs of the distribution grid merely by paying the marginal losses on the distribution grid.

The level of the marginal costs can become very high during periods of high loading on the distribution grid. During periods of high loading on the distribution grid, marginal cost might include opportunity cost or congestion costs as a way to allocate the capacity of the distribution grid. Because a dynamic tariff is part of a competitive market, the utility would have less assurance that it would recover its fixed costs but at the same time might collect more revenue than would be justified under embedded cost ratemaking.

Q. How long would dynamic pricing result in NSTAR Electric earning more than is justified under embedded cost ratemaking?

A. Any earning by NSTAR Electric in excess of the amount specified by embedded cost ratemaking would be short lived. Customers with the ability to install distributed generation would do so. These distributed generators would then deliver electricity to NSTAR Electric at the dynamic price. These deliveries would cut into NSTAR Electric's excess revenue in two ways. First, distributed generation would reduce the energy that NSTAR Electric was delivering at the high delivery prices. Second, distributed generation would reduce the loading on the NSTAR Electric distribution grid. The reduced loading on the NSTAR

Electric distribution grid would lower marginal cost and thus lower the price NSTAR Electric was receiving for providing the distribution service.

BENEFIT TO OTHER CONSUMERS

Q. What would be the effect on other consumers of this action?

A. The lowered price for the use of the distribution grid would show up in lowered prices on the transmission system. The lowered price on the transmission system means lower locational marginal prices. Some customers may pay locational marginal prices by buying electricity directly through ISO New England. But most customers will see a decline in the prices they pay to energy service providers. Energy service providers set their prices at a level to recover the costs that they incur. If the location marginal prices paid by the energy service providers decline, then the prices that the energy service providers demand from their retail customers will also decline. This will benefit other consumers, not just the consumers with distributed generation.

Q. How would NSTAR Electric determine the dynamic price under your plan?

A. NSTAR Electric would need to study each distribution grid on which it would be offering either the interruptible Standby Service or an interruptible distribution service. Under the interruptible Standby Service, NSTAR Electric needs to know the power level that the circuit can handle under normal conditions. When those normal conditions are exceeded, then NSTAR Electric would call for interruption of the Standby Service. Similarly, a study of the distribution grid would provide NSTAR Electric with information about how line losses on the distribution grid change with the loading on the distribution grid. The price charged for use of the distribution grid would then change with the total power measured onto the distribution grid. These relations between line loadings and marginal cost would be set out in a system of equations for each distribution grid.

REACTIVE POWER PRICING

Q. Why did you refer to "total power" in regard to the dynamic pricing of the distribution grid?

A. Engineers deal with total power, active power, and reactive power. However, consumers generally think only of active power which is measured in watts. For instance, most uses of electricity in the home are measured in watts. A light bulb might be 60 watts. An electric stove might have heating elements of 1600 watts. And even ISO New England generally operates a market based in active power, though measured in megawatts, or millions of watts.

But our alternating current (AC) system also provides reactive power. Reactive power creates the magnetic field that is necessary to create a motor. In electrical engineering class at MIT we talked about capacitive loads and inductive loads. Power engineers often feel better talking about leading power and lagging power. Leading and lagging refer to whether the change in the AC current leads or lags the change in the AC voltage. Capacitive loads are leading and inductive (motor) loads are lagging. Unfortunately, NSTAR Electric does not seem to differentiate between leading and lagging loads in its Standby Service tariff.

Total power refers to the sum of the active power and the reactive power.

Q. Where does NSTAR Electric refer to reactive power?

A. NSTAR Electric actually refers to total power on Page 26 of the Direct Testimony of Henry C. LaMontagne, Exhibit NSTAR-HCL-1, when he discusses resetting the contract demand for distributed generation. On Page 25, he specifies that the new contract demand shall be no less than the greatest fifteen minute output of the generator in kilowatts. On Page 26, he specifies that the new contract demand shall be no less than 90% of the greatest fifteen minute output of the generator in kilovolt-amperes. Kilovolt-ampere (kva) is a measure of total power, which includes both active power measured in kilowatts (kw) and reactive power measured in kilovolt-amperes reactive (kvar).

Q. What is the importance of the difference between leading and lagging reactive power?

A. Reactive power will strongly affect the local voltage. Leading (capacitive) reactive power will tend to increase the local voltage. Lagging (magnetic or inductive) reactive power will tend to decrease the local voltage. The presence of many motors in an area will tend to cause excessive voltage drops. Excessive voltage drops can be remedied by installing capacitors on the power lines, in substations, or on customer premises. AEP, my former employer, differentiated between leading and lagging power in its tariffs. The bare reference in Mr. LaMontagne's testimony to kilovolt-amperes does not so differentiate.

Q. Why is it important to differentiate between leading and lagging power?

A. One of the potential advantages of distributed generation is providing reactive power to locations where the voltage is abnormal. When the voltage is low in a location, having the distributed generator provide leading power will tend to correct the problem. Conversely, when the voltage is high in a location, having the distributed generator provide lagging power will also tend to correct the problem. But these voltage problems are generally temporary, suggesting a dynamic price for reactive power. Under the formulation proposed by Mr. LaMontagne, a distributed generator could be penalized for helping NSTAR Electric solve its voltage problem.

Q. How could a distributed generator be penalized for helping NSTAR Electric solve a voltage problem?

A. The typical problem for an electric distribution grid is low voltage, often due to an excessive amount of motors on the distribution grid. A 100 kw distributed generator could generate some leading power, say 60 kvar, helping to increase the local voltage. The result would be 116.6 kva of total power. I must note that the way power engineers measure reactive power versus active power is like the two sides of a right triangle. The sum of the square of the active power and the square of the reactive power is equal to the square of the total power. At 116.6 kva, Mr. LaMontagne's formula would force the distributed generator to pay for 90% of 116.6 kva, or 104.9 kw. Thus, the distributed generator would have to pay for the privilege of helping NSTAR Electric serve its other customers in a better manner.

Q. Would this also be true for dynamic pricing?

A. Dynamic pricing can encourage distributed generators to help the network with its voltage problems. For instance, when voltage is below nominal, the dynamic tariff would pay customers for leading reactive power and charge customers for lagging reactive power. When voltage is above nominal, the dynamic tariff would pay customers with lagging reactive power and would charge customers for leading reactive power.

Q. Is high voltage a problem for electric utilities?

A. High voltage can be a problem for electric utilities. High voltage conditions can cause equipment, like motors, to wear out faster. High voltage conditions frequently occur when capacitors are not well managed. I mentioned earlier that capacitors are placed on distribution lines, in substations, and at industrial facilities to counteract the voltage lowering effects of motors. Sometimes these capacitors are not turned off when the motor load declines, such as at night or on weekends. The decline in the motor load leaves the system imbalanced in regard to reactive power, with too much leading power. This results in voltages that are higher than nominal.

Q. You said that distributed generators can help utilities with local voltage problems. Do distributed generators now operate in such a fashion?

A. Yes. I have been working with the Inadvertent Interchange Payback Task Force of the North American Energy Standards Board. After the February meeting, I discussed distributed generation with a representative of the Sacramento Municipal Utilities District (SMUD). The distributed generator is on one of the campuses of the University of California (UC). When SMUD has low voltage problems in that part of town, SMUD calls upon UC to produce leading reactive power. The leading reactive power raises the voltage near UC, moving it toward nominal. This works very well because of the cooperative relation between SMUD and UC. The lack of a cooperative relation between NSTAR Electric and the distributed generation industry requires a different relation. Without the cooperation between SMUD and UC, SMUD would have to install capacitors or other devices in this remote part of its distribution system to keep the voltage at an acceptable level.

Q. What sort of relation should NSTAR Electric have with distributed generators in regard to reactive power?

A. Obviously, the relation between NSTAR Electric and its distributed generators would have to be tariffed. The tariff needs to set the price for reactive power provided by the distributed generator. The price for reactive power would need to reflect the actual voltage during each meter period versus the nominal voltage during the meter period. When the voltage was higher than nominal, NSTAR Electric would charge the distributed generator for leading reactive power and pay the distributed generator for lagging reactive power. When the voltage was lower than nominal, NSTAR Electric would charge the distributed generator for lagging reactive power and pay the distributed generator for leading reactive power. The price for this reactive power would need to vary with the extent of the difference between the actual voltage and the nominal voltage. The price for the reactive power would also need to vary with the price for active power.

Q. Does this conclude your direct testimony?

A. Yes, it does.